

Atty. Docket No. CPAC 1017-7  
Appl. No. 10/632,550

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**Remarks**

The specification is amended herein to correct errors of a typographical or editorial nature (paragraphs [0068], [0096], [0100]); additionally, paragraph [0002] is amended to update the related applications data. Claims 1, 6, 7, 8, 10, 11 and 12 are amended for improved clarity of presentation, and to correct editorial errors. No new matter is introduced by any of the amendments, and entry thereof is requested.

Claims 1 - 17 are in the application. Reconsideration of the Application, as amended, is requested.

Applicant's invention is directed to multi-package modules (MPM) including stacked first and second packages, each of which includes a die attached to a substrate, in which the first and second substrates are interconnected by wire bonding, and in which at least one of the packages includes a stacked die package. Advantageously, according to the invention, the second package and the first package can be separately tested before assembly, so that second packages not testing as "good" can be discarded and only "good" second packages used in the finished MPM.

The points raised in the Office action will now be addressed.

**Rejections under 35 U.S.C. § 103(a)**

The claims were variously rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma *et al.* U.S. 6,621,169 ("Kikuma"), or over AAPA in view of Kikuma and further in view of additional art. These rejections will be addressed as follows:

- I. as to Kikuma, generally;
- II. as to the claims directed to multi-package modules (claims 1 - 6);
- III. as to claims directed to apparatus including the multi-package modules (claims 16 and 17); and
- IV. as to the claims directed to a method for making multi-package modules (claims 7 - 15).

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L. Kikuma

The Examiner characterized Kikuma as follows:

Kikuma teaches the upper 32 and lower substrates 26 that are interconnected by wire bonding 38b (col. 7, lines 3-41, and figure 3), and the package comprises a stacked die package (col. 11, lines 25-67, col. 12, lines 1-5, and figs. 9A, 9B).

\* \* \*

Kikuma teaches forming electrical interconnects between the first package and the second package by wire bonding (col. 7, lines 38-41, and figure 3).

Applicant, respectfully, disagrees with the Examiner's reading of Kikuma and application of it to Applicant's invention. As explained below, Kikuma does not teach or suggest a multi-package module including stacked packages, as in Applicant's claimed invention; nor does Kikuma teach or suggest a method for making a multi-package module, by providing first and second packages, at least one of which is a stacked die package, stacking one package over the other, and electrically interconnecting the packages by wire bonding.

Kikuma describes a "stacked semiconductor device" having "a plurality of semiconductor chips of desired sizes stacked as one package". The Kikuma device of Fig. 3, for example, is constructed (*see*, Figs. 4A - 4F; Col. 8, line 39 - Col. 9, line 10) by mounting a first semiconductor chip 22 onto a printed circuit board 32 by flip-chip bonding (Fig. 4B). Then the reverse face of the semiconductor chip 22 is attached using an adhesive to a surface of a flexible printed wiring board 26, and a second semiconductor chip 24 is attached using an adhesive to a surface of the printed circuit board 32 (Fig. 4C). Then the printed circuit board 32 is electrically connected to the printed wiring board 26 by bonding wires (effecting electrical connection of the first semiconductor chip 22 to the printed wiring board 26 by way of the printed circuit board); and the second semiconductor chip 24 is electrically connected — also to the printed wiring board — by bonding wires (Fig. 4D). Then "the semiconductor chips and their bonding wires" are encapsulated by an encapsulating resin 40 (Fig. 4F), and solder balls 30 are mounted on the printed wiring board to complete the device (Fig. 4F).

The Kikuma device of Figs. 9A, 9B is constructed in the same way (*see*, Col. 11, lines 15 - 63). These Figs. "show examples in each of which a plurality of semiconductor chips are stacked in accordance with the first embodiment of the present invention." (Col. 11, lines 15 - 17.)

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In the examples of both Fig. 9A and 9B "four semiconductor chips of the same types are stacked, and second substrates are interposed between the semiconductor chips." (Col. 11, lines 17 - 20.)

Thus, Kikuma expressly teaches building up a stacked semiconductor device by serially mounting semiconductor chips, and then forming electrical connection of the chips by wire bonding. Kikuma does not teach or suggest a multi-package module having stacked packages in which at least one package is an encapsulated stacked die package, nor a method for making such a multi-package module by stacking packages, as in Applicant's invention as claimed.

## II. Multi-package module claims 1 - 6

### A. Claims 1 - 4.

Claims 1 - 4 were rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma *et al.* U.S. 6,621,169 ("Kikuma").

Regarding claim 1, the Examiner asserted that "AAPA, in related text ([0019], [0020]), discloses a multi-package module comprising stacked lower and upper packages, each package including a die 24 or 14 attached to a substrate 22 or 12." The Examiner acknowledged that "AAPA does not disclose the upper and lower substrates are interconnected by wire bonding and at least one package comprises a stacked die package". The Examiner stated that

Kikuma teaches the upper 32 and lower substrates 26 that are interconnected by wire bonding 38b (col. 7, lines 3-41, and figure 3), and the package comprises a stacked die package (col. 11, lines 25-67, col. 12, lines 1-5, and figs. 9A, 9B).

The Examiner argued that it would have been obvious

to form the upper and lower substrates that are interconnected by wire bonding, and the package comprises a stacked die package, as taught by Kikuma in order to develop portable electronic devices such as mobile telephones and non-volatile memory media such as IC memory cards have been becoming smaller and smaller. Along with this trend, there have been demands for devices and memory having a smaller number of components and smaller size (col. 1, lines 15-20), and without increasing the length of the bonding wires in the packages (col. 5, lines 28-35).

As to claim 2 the Examiner asserted that "AAPA discloses the claimed invention except for the lower package comprises a stacked die package. However, Kikuma teaches the package comprises a stacked die package (col. 11, lines 25-67, col. 12, lines 1-5, and figs. 9A, 9B)", and

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again argued that it would have been obvious "to form the package that comprises a stacked die package, as taught by Kikuma ..."

As to claim 3, the Examiner asserted that "AAPA discloses the claimed invention except for the multi-package module wherein each of the lower and upper package comprises a stacked die package. However, Kikuma teaches each of the packages comprises a stacked die package (col. 11, lines 25-67, col. 12, lines 1-5, and figs. 9A, 9B)", and argued that it would have been obvious "to form each of the packages comprises a stacked die package, as taught by Kikuma ..."

As to claim 4, the Examiner asserted that "AAPA discloses the claimed invention except for the multi-package module wherein the upper package comprises a stacked die package. However, Kikuma teaches each of the packages comprises a stacked die package (col. 11, lines 25-67, col. 12, lines 1-5, and figs. 9A, 9B)", and argued that it would have been obvious "to form the package comprises a stacked die package, as taught by Kikuma ..."

These rejections are traversed. Applicant describes in background (referring to Figs. 2, 3, 4) various multi-package modules, having various forms of z-interconnection between the packages in the stack -- none of these suggests wire bond z-interconnection between packages. It is therefore not true, as the Examiner states, as to claim 2, that "AAPA discloses the claimed invention except for the lower package comprises a stacked die package" or, as to claim 3, that "AAPA discloses the claimed invention except for the multi-package module wherein each of the lower and upper package comprises a stacked die package" or, as to claim 4, that "AAPA discloses the claimed invention except for the multi-package module wherein the upper package comprises a stacked die package". Applicant's description of the art fails to teach a multi-package module having wire bond interconnect between the stacked packages.

Nor can Kikuma supply such a teaching or suggestion, for the reasons set forth above. In fact, to the extent Kikuma may be relevant, it teaches away from Applicant's invention.

The Examiner's reference to Kikuma Col. 1, lines 15-20 and Col. 5, lines 28-35, is not well understood. Advantages provided by using wire bond interconnect between stacked packages in a multi-package module according to the invention are described in Applicant's specification at, for example, paragraph [0030].

No combination of Kikuma and "AAPA" makes Applicant's invention, and these rejections should be withdrawn.

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B. Claim 5

Claim 5 was rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma and further in view of LoBianco *et al.* U.S. 6,340,846 ("LoBianco"). The Examiner asserted that "AAPA in view of Kikuma discloses the claimed invention except for the adjacent stacked dies in the stacked package are separated by a spacer. However, LoBianco teaches the stacked dies in the stacked package are separated by a spacer 50 (col. 6, lines 49-52, and fig. 8)", and the Examiner argued that it would have been obvious "to form the stacked dies in the stacked package that are separated by a spacer, as taught by LoBianco in order to enhance component density of the package and to provide a simple, inexpensive method for making a semiconductor package with stacked dies that eliminated fracturing of dies during the wire bonding process or as a result of incompatible thermal expansions, and that also eliminates the problem of broken wire bonds as a result of wire sweep (col. 1, lines 38, lines 54-59)."

This rejection is traversed. Applicant disagrees with the Examiner's reading of Kikuma and of Applicant's discussion in background, as explained above. LoBianco is relied upon as teaching a spacer between stacked die. LoBianco cannot supply what Kikuma and "AAPA" lack.

No combination of "AAPA" and Kikuma and LoBianco teaches or suggests Applicant's claimed invention, and this rejection should be withdrawn.

C. Claim 6

Claim 6 was rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma and further in view of Bertin *et al.* U.S. 5,977,640 ("Bertin"). The Examiner acknowledged that AAPA in view of Kikuma does not teach "the multi-package module further comprising a heat spreader over the second package", but asserted that "Bertin teaches the heat spreader over the component (col. 4, lines 16-17, and fig. 7)", and argued that it would have been obvious "to form the heat spreader over the component, as taught by Bertin in order to allow for heat dissipation for ship-on-chip component. (col. 4, lines 18-19)."

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This rejection is traversed. Applicant disagrees with the Examiner's reading of Kikuma and of Applicant's discussion in background, as explained above. Bertin is relied upon as teaching a heat spreader. Bertin cannot supply what Kikuma and "AAPA" lack.

No combination of "AAPA" and Kikuma and Bertin teaches or suggests Applicant's claimed invention, and this rejection should be withdrawn.

### III. Apparatus claims 16, 17

As to claim 16 the Examiner asserted without further discussion that "AAPA discloses a mobile device comprising the multi-package module (specification [0004])." As to claim 17 the Examiner asserted without further discussion that "AAPA discloses a mobile computer comprising the multi-package module (specification [0004])."

This rejection is not well understood. To the extent it may be understood, it is traversed. Applicant's description in background says nothing about Applicant's invention as claimed in claim 1, and so it cannot by itself render obvious the invention as claimed in claims 16 and 17, which recite "the multi-package module of claim 1".

"AAPA ... (specification [0004])" does not suggest Applicant's claimed invention, and this rejection should be withdrawn.

### IV. Method claims

#### A. Claims 7, 10, 11, 14 - 15

Claims 7, 10, 11, 14 - 15 were rejected over Applicant's discussion in background ("AAPA") in combination with Kikuma. These rejections are traversed.

As to claim 7, the Examiner asserted that "AAPA discloses a method for making a multi-package module, providing a stacked die first package providing a second package, stacking the second package over the first package (fig. 2)." The Examiner acknowledged that "AAPA does not disclose forming electrical interconnects between the first package and the second package by wire bonding." The Examiner stated that

Kikuma teaches forming electrical interconnects between the first package and the second package by wire bonding (col. 7, lines 38-41, and figure 3).

The Examiner argued that it would have been obvious

to form electrical interconnects between the first package and the second package by wire bonding, as taught by Kikuma in order to

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develop portable electronic devices such as mobile telephones and non-volatile memory media such as IC memory cards have been becoming smaller and smaller. Along with this trend, there have been demands for devices and memory having a smaller number of components and smaller size (col. 1, lines 15-20), and without increasing the length of the bonding wires in the packages (col. 5, lines 28-35).

As to claims 10 and 11, the Examiner asserted that "AAPA discloses the method of forming a stacked die first package comprising providing an unsingulated strip of stacked die packages wherein a first die 14 affixed to a first package 12, a second die affixed over the first die 14 (fig. 2). The Examiner acknowledged that AAPA does not disclose wire bond interconnects between the first and second dies and the substrate", but asserted that "Kikuma teaches wire bond interconnects between the first and second dies and the substrate (col. 7, lines 38-41, and figure 3)", and argued that it would have been obvious to form wire bond interconnects between the first and second dies and the substrate, as taught by Kikuma ..."

As to claim 14, the Examiner asserted without further discussion that "AAPA discloses the method further comprising attaching second-level interconnect balls onto the first package substrate (fig. 2)."

As to claim 15, the Examiner asserted without further discussion that "AAPA discloses the method further comprising encapsulating the stacked packages on the module in a molding compound 27 (specification: [0019], fig.2)."

Applicant, respectfully, disagrees with the Examiner's reading of Kikuma, and of Applicant's discussion in background, as explained above. To the extent it may be relevant, Kikuma teaches away from Applicant's invention.

No combination of Kikuma and Applicant's discussion in background makes Applicant's claimed invention, and these rejections should be withdrawn.

B. Claims 8, 9, 12, 13 were rejected over AAPA in combination with Kikuma and further in combination with additional art.

Claims 8 and 9 were rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma and further in view of Akiba *et al.* U.S. Publication No. 2004/0016939 ("Akiba").

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As to claim 8, the Examiner acknowledged that AAPA in view of Kikuma does not teach "the method wherein providing a stacked die first package comprises testing the stacked die packages for a performance and reliability requirement, and identifying a package that meets the requirement as a first package", and as to claim 9, the Examiner acknowledged that AAPA in view of Kikuma does not teach "the method wherein providing a second package comprises testing packages for a performance and reliability requirement, and identifying a package that meets the requirement as a second package"; then the Examiner asserted that "Akiba teaches testing packages (page 8, [0078])", and argued that it would have been obvious "to test packages, as taught by Akiba in order to improve manufacturing yields and reduce costs (page 8, [0074])."

Claim 12 was rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma and further in view of LoBianco *et al.* U.S. 6,340,846 ("LoBianco") on the same grounds as for claim 5. Particularly, the Examiner asserted that "AAPA in view of Kikuma discloses the claimed invention except for the adjacent stacked dies in the stacked package are separated by a spacer. However, LoBianco teaches the stacked dies in the stacked package are separated by a spacer 50 (col. 6, lines 49-52, and fig. 8)", and argued that it would have been obvious "to form the stacked dies in the stacked package that are separated by a spacer, as taught by LoBianco in order to enhance component density of the package and to provide a simple, inexpensive method for making a semiconductor package with stacked dies that eliminated fracturing of dies during the wire bonding process or as a result of incompatible thermal expansions, and that also eliminates the problem of broken wire bonds as a result of wire sweep (col. 1, lines 38, lines 54-59)."

Claim 13 was rejected under 35 U.S.C. § 103(a) for obviousness over Applicant's discussion in background ("AAPA") in view of Kikuma and further in view of Bertin *et al.* U.S. 5,977,640 ("Bertin") on the same grounds as for claim 6. Particularly, the Examiner acknowledged that AAPA in view of Kikuma does not teach "the multi-package module further comprising a heat spreader over the second package", but asserted that "Bertin teaches the heat spreader over the component (col. 4, lines 16-17, and fig. 7)", and argued that it would have been obvious "to form the heat spreader over the component, as taught by Bertin in order to allow for heat dissipation for chip-on-chip component. (col. 4, lines 18-19)."

These rejections are traversed, at least for the reasons given above with respect to claims 7, 10, 11, 14 - 15. None of Akiba, LoBianco or Bertin can supply what is lacking Kikuma and



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Applicant's discussion in background, and none of the cited combinations makes Applicant's claimed invention.

Accordingly, the rejections for obviousness should be withdrawn.

In view of the foregoing, all the claims now in the application are believed to be in condition for allowance, and action to that effect is respectfully requested

This Response is being filed within the third month following the three months' shortened statutory period set by the Examiner for response to the Office action and, accordingly, it is accompanied by a Petition for three months' extension of time and a fee or fee authorization therefor. The Commissioner is authorized to charge any additional fee (or to credit any overpayment) in connection with this paper to Deposit Account No. 50-0869 (CPAC 1017-7).

If the Examiner determines that a conference would facilitate prosecution of this application, the Examiner is invited to telephone Applicants' representative, undersigned, at the telephone number set out below.

Respectfully submitted,  
  
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